Does the change from using classical differential geometry in general relativity to using entirely discrete quantum gravity remove the zero-time singularity and tell us what happened before the Big Bang?

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Abstract

In conventional 4-dimensional Lorentzian general relativity, the Big Bang appears as a curvature singularity arising from the assumption of a smooth differentiable manifold and a single time dimension. In the mechanistic 3-time/3-space Euclidean quantum field theory developed in earlier work, the continuum assumptions are replaced by discrete vacuum-polarization events and sums over histories. This paper shows that, once the continuum limit is removed, the Big Bang singularity disappears and is replaced by a finite, discrete Euclidean configuration of vacuum events. Lorentzian time emerges as a vacuum-polarization phase transition, not a creation event. We discuss the implications for cyclic cosmology and examine whether a finite pre-Bang configuration could, in principle, encode information from a prior cosmic cycle, including the speculative possibility of engineered high-energy configurations analogous to a 10^{55} megatons "space burst." We conclude that while the discrete pre-Bang state is compatible with cyclic cosmology, it does not provide evidence for intentional engineering, though it does not rule it out.

1 Introduction

The classical Big Bang singularity is a mathematical artefact of:

1. a single time dimension,
2. a smooth Lorentzian metric,
3. differentiable curvature tensors,
4. and the assumption that spacetime remains continuous at arbitrarily small scales.

In the mechanistic Euclidean QFT framework, none of these assumptions hold. The fundamental structure is:

- 3 spatial dimensions,
- 3 temporal dimensions,
- Euclidean signature,
- discrete vacuum-polarization events,
- sum-over-histories dynamics,
- emergent Lorentzian time.

This paper examines the consequences for the origin of the universe.

2 Discreteness Removes the Singularity

The Big Bang singularity arises because the scale factor $a(t)$ is assumed to be a smooth function satisfying differential equations. When integrals are replaced by explicit discrete sums,

$$\int \longrightarrow \sum,$$

the scale factor is no longer defined at arbitrarily small scales. Instead, the early universe is described by a *finite set of vacuum-polarization events* in a small region of 6-dimensional Euclidean space.

Curvature scalars cannot diverge because curvature is not defined until the vacuum becomes smooth enough for the polarization tensor $\Pi(p)$ to admit second derivatives.

Thus:

The early universe is a finite discrete configuration, not a point.

3 Two Complementary Sums Over Histories

In the mechanistic Euclidean framework, the continuum path integral is replaced everywhere by explicit discrete sums over histories. Because the theory contains three spatial and three temporal dimensions, there are two distinct classes of histories:

1. spatial paths of particles between fixed spatial endpoints, and
2. temporal histories of the entire universe between fixed Euclidean times.

Both are required for a complete description of quantum dynamics. The first describes ordinary particle propagation. The second describes the evolution of the universe through the pre-Bang Euclidean phase.

3.1 Spatial Sum Over Paths

For a particle propagating from spatial point x_a to x_b during a Euclidean time interval $[0, T]$, the spatial sum over histories is

$$P_{\text{space}}(x_b, x_a; T) = \mathcal{N}_{\text{space}} \sum_{x(\tau)} \sum_{y(\tau)} \cos\left(\frac{S_E[x] - S_E[y]}{\hbar} \right), \tag{1}$$

with boundary conditions

$$x(0) = y(0) = x_a, \qquad x(T) = y(T) = x_b.$$

The Euclidean action for a spatial path is

$$S_E[x] = \int_0^T d\tau \, \left[\frac{m}{2} \dot{x}^2(\tau) + V(x(\tau)) \right]. \tag{2}$$

Equation (1) is the usual path integral rewritten as a double-history cosine kernel, appropriate for a discrete vacuum in which continuous trajectories do not exist at small scales.

3.2 Time-History Sum Over Universe States

The second sum is over *time histories* of the entire universe between two Euclidean times τ_i and τ_f. A time history is represented by a sequence of discrete "macro-states"

$$s(\tau_n) \in \{\text{vacuum}, \, e^+e^-, \, \gamma\gamma, \, \ldots\}, \qquad \tau_n = \tau_i + n \, \Delta\tau,$$

describing the global configuration of the universe at each Euclidean time slice. The corresponding sum over histories is

$$P_{\text{time}}(\tau_f, \tau_i) = \mathcal{N}_{\text{time}} \sum_{s(\tau)} \sum_{s'(\tau)} \cos\left(\frac{S_E[s] - S_E[s']}{\hbar} \right), \tag{3}$$

with fixed boundary conditions

$$s(\tau_i) = s'(\tau_i) = \text{initial macro-state}, \qquad s(\tau_f) = s'(\tau_f) = \text{final macro-state}.$$

The Euclidean action for a time history is

$$S_E[s] = \sum_n \Delta\tau \, \mathcal{L}_E(s(\tau_n)), \tag{4}$$

where $\mathcal{L}_E$ assigns Euclidean energy to each discrete macro-state and includes contributions from creation, annihilation, and transition events.

Equation (3) is the temporal analogue of the spatial sum (1). It describes the interference of all possible Euclidean time histories of the universe. The classical Big Bang trajectory emerges as the stationary-phase resultant of this double sum, after destructive interference eliminates the vast majority of non-classical histories.

4 Emergence of Lorentzian Time as a Phase Transition

The effective metric is defined by

$$g_{\mu\nu}^{\text{eff}} \propto \frac{\partial^2 \Pi}{\partial p_\mu \partial p_\nu},$$

where Π is a sum over discrete histories:

$$\Pi(p) = \sum_h w(h) \cos\left(\frac{S_E[h]}{\hbar}\right).$$

As the density of vacuum events increases, Π becomes smooth enough to differentiate, and one of the three Euclidean time axes becomes timelike. This is the *birth of Lorentzian time*, not the birth of the universe.

The Big Bang is therefore:

a vacuum-polarization phase transition, not a singularity.

5 The Pre-Bang State as a Finite Configuration

The pre-Bang universe is a finite Euclidean cluster of vacuum events with:

- finite extent,
- finite energy density,
- no singularities,
- no causal structure,
- no preferred time direction.

The universe does not begin at a point; it begins when the vacuum becomes polarized enough to define a timelike direction.

6 Cyclic Cosmology and Pre-Bang Information

A finite pre-Bang configuration is compatible with cyclic cosmology:

- The universe may undergo repeated Euclidean $\rightarrow$ Lorentzian transitions.
- Each cycle begins with a finite Euclidean seed.
- Information may propagate between cycles via conserved topological structures.

This resembles Penrose's conformal cyclic cosmology, but without conformal rescaling and without the mathematical issues in the CCC appendices.

7 Could the Pre-Bang State Be Engineered?

We now address the speculative question: could a finite Euclidean pre-Bang configuration be the result of intentional engineering in a prior cycle?

7.1 What the theory implies

- The pre-Bang state is finite.
- It has a definite energy content.
- It could, in principle, encode structured information.
- It could arise naturally from vacuum-polarization dynamics.
- It could also arise from engineered high-energy processes.

7.2 What the theory does not imply

- There is no evidence of engineering.
- There is no signature of intentional design.
- There is no requirement for a 10^{55} megatons engineered detonation.

7.3 What is possible but not yet proved

An advanced civilization in a prior cycle could, in principle, create a high-energy configuration that seeds the next universe. The mechanistic QFT framework allows:

- vacuum-polarization engineering,
- manipulation of graviton flux,
- creation of microscopic horizons,
- assembly of high-energy Euclidean seeds.

8 Conclusion

Replacing integrals with discrete sums removes the Big Bang singularity and replaces it with a finite Euclidean configuration of vacuum events. Lorentzian time emerges as a phase transition driven by vacuum polarization. This framework is compatible with cyclic cosmology and does not require a singular origin.

The idea that a prior-cycle civilization engineered a high-energy seed is not supported by the physics, but it is not ruled out. The discrete pre-Bang state is too coarse to distinguish natural from engineered origins.

References

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